



Original Article

Ethnic differences in self-reported sleep duration in the Netherlands – the HELIUS study

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ABSTRACT

Background: We investigated ethnic differences in sleep duration, and the contribution of socio-economic status (SES) to the observed differences in Amsterdam, the Netherlands.**Methods:** 6959 participants (aged 18–71 years) from the multi-ethnic HELIUS cohort were studied. Outcome variables were short sleep (<7 h/night) and long sleep (≥9 h/night). Comparisons among groups were made using Prevalence Ratios (PRs).**Results:** Ethnic minority groups were more likely than ethnic-Dutch to report short sleep, with prevalence ranging from 15.1% to 49.7% in men and 16.3% to 41.4% in women. Among men, the age-adjusted PRs ranged from 2.15 (95% CI 1.72–2.69) in Turkish to 3.31 (2.75–3.99) in Ghanaians; and among women, from 1.62 (1.30–2.01) in Turkish to 2.52 (2.15–2.95) in African-Surinamese, respectively. The prevalence of long sleep was significantly higher only in Moroccan men and all the ethnic minority women than in ethnic-Dutch women except for African-Surinamese. Adjustment for SES explains the ethnic difference in long sleep, but not for short sleep.**Conclusion:** Ethnic minority groups reported more short sleep than ethnic-Dutch, while there were no ethnic differences in long sleep. Further study is needed to investigate how this finding on short sleep may contribute to ethnic differences in health outcomes.

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1. Introduction

Evidence demonstrates clear ethnic differences in health outcomes such as CVD and its related risk factors [1–6], mental health [7,8], and health care utilization [9] across the globe. The drivers of the ethnic differences in health outcomes are poorly characterized. Sleep is increasingly being recognized as a factor that might have an impact on health, and may play an important role in the observed differences in health outcomes between ethnic minority groups and the host majority populations. Both short and long sleep duration are established correlates of poor health outcomes [10]. Very little, however, is known about the differences in sleep duration among ethnic minorities and their potential role in health. One of the reasons may be that data on ethnic differences in sleep patterns are limited, and the existing data mainly from the USA show

conflicting results. For example, recent studies found distinct variations in sleep duration between ethnic minority groups and White Americans [11,12]. A similar study also found that African Americans had a longer sleep duration (≥8 h/night) [13] than White Americans. On the other hand, some reports indicate that African Americans, Hispanics, and Asians in the USA also have shorter sleep duration (≤7 h/night) than White Americans [14,15].

Socio-economic difference in sleep is important for understanding how habitual sleep can be influenced. There is also discrepancy in reports concerning the association of socio-economic status (SES) with sleep (duration) among various ethnic groups. For instance, it has been reported that ethnic groups with a lower SES report less sleep duration and/or poorer sleep quality than those with higher SES [16–18]. In addition, in a study involving African Americans, Hispanics, Asians, and White Americans, Grandner and colleagues [19] found that lower income, educational attainment, and unemployment were associated with more sleep complaints. A similar study by Mezick and colleagues [20] indicated that African Americans in lower SES group may be more at risk for sleep disturbances and the associated health consequences. However, one study found that education was not related to sleep in a study population consisting of African American, White American, and Chinese

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women [21]. Put together, it appears that differences in SES in relation to sleep duration may differ between ethnic groups.

Shift work is also known to affect sleep, particularly night shift [22]. Studies indicate that ethnic minority groups appear to do more shift work than the host population [23], hence shift work may also contribute to ethnic differences in sleep duration.

In Europe, there are no data on ethnic differences in sleep duration. Thus, the purpose of the present study was to examine ethnic differences in self-reported sleep duration between the ethnic-Dutch and several ethnic minority groups using a Dutch population-based study. Further, we assessed the contribution of socio-economic indicators to the observed differences in sleep duration among the ethnic groups.

2. Study population and methods

2.1. Study population

The current study was based on baseline data from the HELIUS (Healthy Life in an Urban Setting) study. The aims and design of the HELIUS study have been described elsewhere [24]. In brief, HELIUS is a large-scale prospective cohort study on health and health care among different ethnic groups living in Amsterdam. The study started in 2011 and included individuals aged 18–70 years from the six major ethnic groups in Amsterdam (African-Surinamese, South Asian-Surinamese, Turkish, Moroccan, Ghanaian, and European descent Dutch (henceforth referred to as ethnic-Dutch). It focused on three major disease categories: cardiovascular disease, mental health, and infectious diseases. Participants were randomly sampled from the municipal registers, stratified by ethnicity. The study protocols were approved by the AMC Ethical Review Board.

Baseline data collection is still ongoing. For the current study, baseline data that were collected until June 2013 were used, including 7307 participants whose data from the HELIUS questionnaire were available. Participants with a Javanese Surinamese background ($n = 113$), other/unknown Suriname background ($n = 109$) or other/unknown background ($n = 15$) were excluded because of the small sample sizes. In addition, individuals with no data on sleep duration were also excluded from the analysis (111). This resulted in a dataset of 6959 participants, including 1767 ethnic Dutch, 1812 African-Surinamese, 1156 South-Asian Surinamese, 1117 Ghanaians, 844 Turkish, and 263 Moroccans. Information on demographic, sleep duration, socio-economic indicators, and shift work were collected through a questionnaire.

2.2. Measurements

2.2.1. Sleep

Participants were asked to provide information on the average number of hours they usually sleep at night. Sleep duration was assessed using the item “How many hours do you sleep on average per night?” Sleep duration was categorized according to the standard recommendations of the National Sleep Foundation [25]. For adults, 7–9 h/night is recommended. Short sleep is defined as having less than 7 hours of sleep per night, and long sleep as having 9 or more hours of sleep per night.

2.2.2. Ethnicity

Participant's ethnicity was defined according to the country of birth as well as that of his/her parents. Specifically, a participant is considered an ethnic minority if he/she fulfils either of the following criteria: (1) he or she was born abroad and has at least one of his/her parents born abroad; or (2) he or she was born in the Netherlands but has both his/her parents born abroad [26]. The Surinamese are migrants from Suriname which is a former Dutch colony in South America. Surinamese people who have an African-Caribbean

background are mostly of West African descent, while those with a South Asian background have North Indian origins. They all migrated from Suriname to the Netherlands due to the political instability, in Suriname in 1975 and 1980. Ghanaians migrated to the Netherlands between 1974 and 1983 predominantly for economic reasons, and others such as drought, political instability and the deportation of Ghanaians from Nigeria in the early 1990s. The Turkish and Moroccans migrated to the Netherlands in the 1960s and early 1970s to fill labour shortages which were lacking in unskilled occupations. In 1970–1980, Turkish and Moroccans guest workers brought their spouses and children to the Netherlands.

2.2.3. Socio-economic indicators

Socio-economic indicators were assessed through participant's highest level of education (either in the Netherlands or in the country of origin) and the current employment status. Participants were categorized as those who have never been to school or had elementary schooling only (1st category), those with lower vocational schooling or lower secondary schooling (2nd category), those with intermediate vocational schooling or intermediate/higher secondary education schooling (3rd category), and those with higher vocational schooling or university (4th category). For the current analyses, the first two categories were combined because of small sample size. Employment was categorized into those who were employed and those who were not.

2.2.4. Shift work

Information on shift work was obtained by asking the participants if they do shift in their work schedules and if they have irregular working hours including night work. Shift work was assessed using the item “Do you work irregular hours, including services during night hours?”

2.3. Data analysis

Baseline data were expressed as percentages or means with 95% CI. Chi-square tests were used to test the differences in categorical variables between ethnic groups. Comparisons among ethnic groups were made using Prevalence Ratios (PRs). To assess the contribution of socio-economic indicators to the ethnic differences in sleep, education and employment were included in the regression models. The change in PRs, before and after adjustment, was used to assess the relative contribution of socio-economic indicators to the ethnic differences in sleep duration. The same was done for shift work. Interaction effect between ethnicity and socio-economic indicators was also assessed. All analyses were performed using STATA 11.0 (Stata Corp, Station, TX). A p -value of <0.05 was considered as statistically significant.

3. Results

3.1. Characteristics of the study population

Table 1 shows the characteristics of the study population by ethnic group and sex. Turkish and Moroccan men and women, and Ghanaian women were younger, less employed, and had lower educational levels than the ethnic-Dutch and other ethnic groups. South-Asian Surinamese men and African-Surinamese women have higher prevalence of shift work compared with other ethnic groups.

3.2. Sleep duration

Figure 1 shows the mean sleep duration (hours per night) in men and women by ethnic group. Among men, the mean sleep duration levels were significantly lower in all the ethnic minority groups (ranging from 6.6 to 7.1 h/night) than in ethnic-Dutch (7.3 h/

Table 1

Characteristics of study population by sex and ethnicity.

	Dutch	South-Asian Surinamese	African Surinamese	Ghanaian	Turkish	Moroccan
Men	<i>n</i> = 816	<i>n</i> = 549	<i>n</i> = 685	<i>n</i> = 455	<i>n</i> = 396	<i>n</i> = 138
Age	47.4 (46.5, 48.4)	44.9 (43.8, 46.1)	46.8 (45.8, 47.8)	47.4 (46.3, 48.6)	40.2 (39.1, 41.4)	40.8 (38.7, 42.8)
Shift work (% yes)	24.7 (22, 28)	37.5 (33, 42)	46.8 (45.8, 47.8)	27.5 (23, 32)	30.8 (26, 36)	34.9 (27, 43)
Employed (% yes)	90.3 (86, 94)	81.8 (76, 87)	90.8 (87, 95)	87.5 (82, 93)	76.3 (69, 84)	83.7 (73, 94)
Education						
None or Primary (%)	3.43 (2.18, 4.68)	16.6 (13.5, 19.8)	7.67 (5.66, 9.68)	12.9 (9.81, 16.0)	28.4 (23.9, 32.8)	27.0 (19.5, 34.5)
Secondary (%)	39.1 (37.7, 42.4)	63.1 (59.0, 67.1)	75.7 (72.4, 78.9)	68.6 (64.3, 72.9)	57.5 (52.6, 62.4)	58.4 (50.1, 66.7)
Tertiary (%)	57.5 (54.1, 60.9)	20.3 (16.9, 23.7)	16.7 (13.9, 19.5)	18.5 (14.9, 22.1)	14.2 (10.7, 17.6)	14.6 (8.7, 20.5)
Women	<i>n</i> = 951	<i>n</i> = 607	<i>n</i> = 1127	<i>n</i> = 662	<i>n</i> = 448	<i>n</i> = 125
Age	45.9 (45.0, 46.8)	46.9 (46.0, 48.0)	46.8 (46.2, 47.6)	43.5 (42.6, 44.4)	39.7 (38.5, 40.8)	41.0 (38.9, 43.2)
Shift work (% yes)	16.7 (14, 19)	17.9 (15, 21)	22.5 (20, 25)	15.2 (12, 18)	8.1 (5, 11)	15.9 (8, 24)
Employed (% yes)	86.8 (83, 91)	78.9 (74, 84)	86.3 (83, 90)	80.8 (77, 85)	44.5 (39, 51)	48.1 (37, 59)
Education						
None or Primary (%)	2.65 (1.62, 3.68)	17.0 (14.0, 20.0)	5.35 (4.03, 6.67)	35.4 (31.8, 39.1)	40.7 (36.2, 45.3)	39.2 (30.6, 47.8)
Secondary (%)	38.7 (35.6, 41.8)	63.5 (59.6, 67.3)	68.0 (65.3, 70.7)	59.7 (55.9, 63.4)	45.9 (41.2, 50.5)	48.8 (40.0, 57.6)
Tertiary (%)	58.6 (55.5, 61.8)	19.5 (16.3, 22.7)	26.7 (24.1, 29.2)	4.91 (3.25, 6.57)	13.4 (10.3, 16.6)	12.0 (6.28, 17.7)

Data are presented as mean and percentages with 95% CI.

night), with Ghanaians and African Surinamese reporting the lowest mean sleep duration. Among women, the mean sleep duration levels range from 6.7 to 7.3 h/night in ethnic minority groups and 7.3 h/night in the ethnic-Dutch, with African-Surinamese reporting the lowest mean sleep duration.

3.3. Short sleep

Figure 2a shows the prevalence of short sleep in men and women by ethnic group. The prevalence of short sleep was lower in ethnic-Dutch compared with all ethnic minority groups in both men and women. Table 2 shows that these ethnic differences were significant after adjusting for age, socio-economic indicators (education and employment), and shift work with PRs ranging from 2.31 (95% CI, 1.25–4.26) in Moroccan men to 3.49 (95% CI, 2.33–5.22) in Ghanaian men compared with ethnic-Dutch men, and 1.64 (95% CI, 1.07–2.50) in Turkish women to 2.27 (95% CI, 1.71–3.00) in African-Surinamese women compared with ethnic-Dutch women.

When <5 hours and 5–6 hours were used as cutoff for very short sleep and short sleep, after adjusting for SES, observed ethnic differences in very short sleep persisted except for South-Asian Surinamese and Turkish men, and for Turkish and Moroccan women; the ethnic differences in short sleep also persisted after adjusting

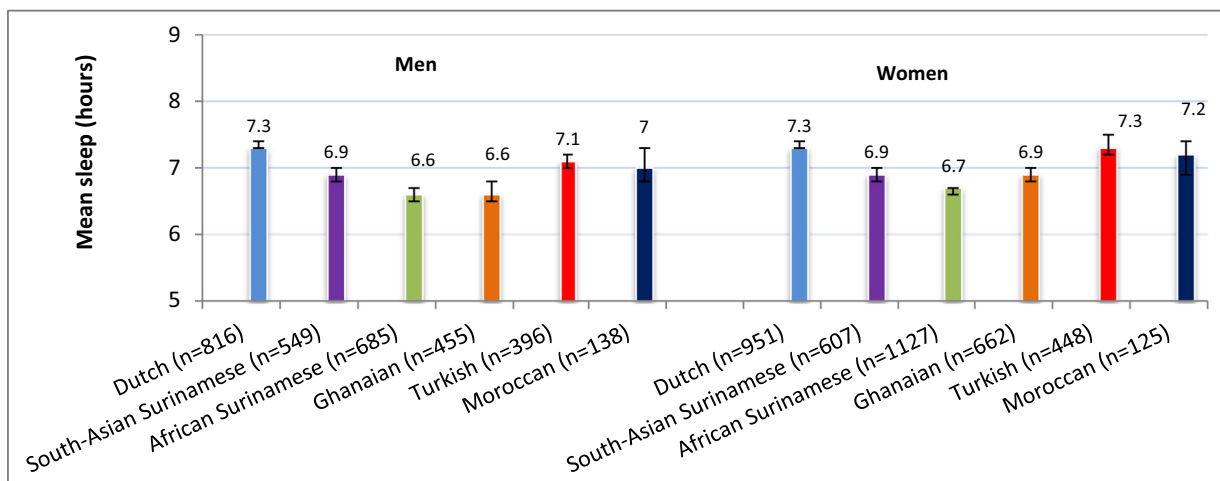
for SES except for Moroccan and women (supplementary Table S1 in the online version at doi:10.1016/j.sleep.2014.04.019).

3.4. Long sleep

Figure 2b shows the prevalence of long sleep among ethnic groups as compared with ethnic-Dutch. The prevalence of long sleep was low among all ethnic groups, ranging from 3.4% to 9.4% in men and from 5.6% to 12.0% in women. Table 3 shows that in men, compared with ethnic-Dutch, the age-adjusted PR of long sleep was significantly higher only in Moroccan men (PR = 1.91 95% CI 1.05–3.48), but the difference disappeared after adjusting for education, employment and shift work (PR = 1.04 95% CI 0.40–2.71). In women, compared with ethnic-Dutch, the age-adjusted PR of long sleep was significantly higher in South-Asian Surinamese (PR = 1.58, 1.06–2.36), Ghanaians (PR = 1.77, 1.20–2.61), Turkish (PR = 1.97, 1.24–3.13) and Moroccans (PR = 2.92, 1.61–5.29) respectively. The differences disappeared after further adjustment for SES.

3.5. Association between socio-economic indicators and sleep

We observed a negative association between short sleep and educational level for the ethnic-Dutch only, whereas for the other ethnic

**Fig. 1.** Mean sleep duration (hours per night) with 95% CI among ethnic groups by gender.

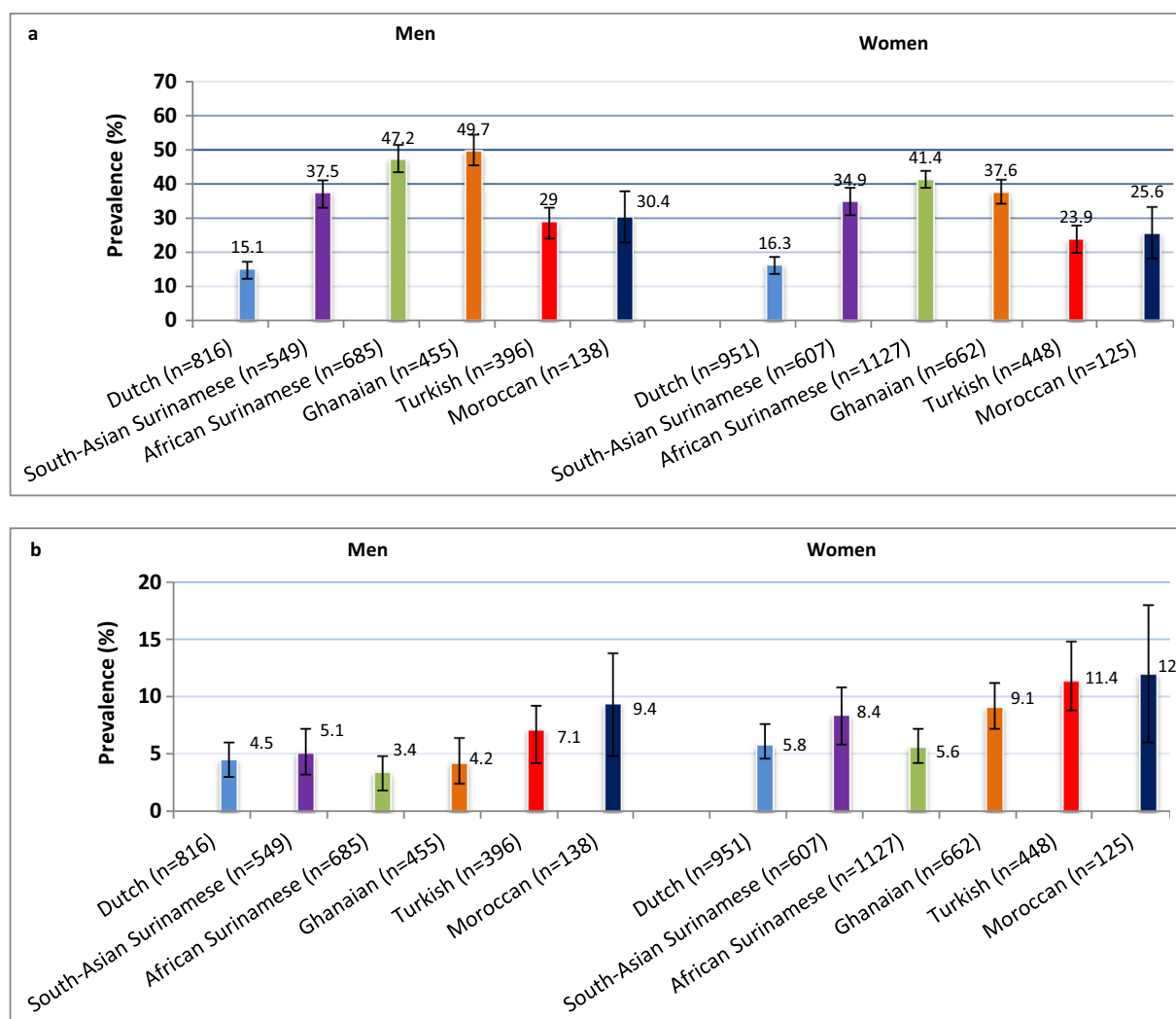


Fig. 2. (a) Prevalence short sleep with 95% CI among ethnic groups by gender. (b) Prevalence long sleep with 95% CI among ethnic groups by gender.

groups, no association was observed (Fig. annex 3a and b in the online version at doi:10.1016/j.sleep.2014.04.019). For long sleep, there was significant positive association between educational attainment and long sleep in African Surinamese men only (Fig. annex 4a and b in the online version at doi:10.1016/j.sleep.2014.04.019). Whereas a significant positive association

between employment and short sleep was observed in South-Asian Surinamese men and African Surinamese women (Fig. annex 5a and b in the online version at doi:10.1016/j.sleep.2014.04.019), there was a significant positive association between employment and long sleep, but only in ethnic-Dutch women (Fig. annex 6a and b in the online version at doi:10.1016/j.sleep.2014.04.019). For short

Table 2

Prevalence ratio(s) for short sleep among ethnic minority groups compared with ethnic Dutch.

	Dutch	South-Asian Surinamese PR (95% CI)	African Surinamese PR (95% CI)	Ghanaian PR (95% CI)	Turkish PR (95% CI)	Moroccan PR (95% CI)
Men	n = 816	n = 549	n = 685	n = 455	n = 396	n = 138
Short sleep (<7 h/night)						
Model 1	1.00	2.59 (2.13–3.14)*	3.16 (2.64–3.79)*	3.31 (2.75–3.99)*	2.15 (1.72–2.69)*	2.23 (1.65–3.01)*
Model 2	1.00	2.60 (1.92–4.17)*	3.12 (2.14–4.53)*	3.38 (2.29–5.00)*	2.75 (1.77–4.28)*	2.69 (1.54–4.69)*
Model 3	1.00	2.98 (1.99–4.44)*	3.07 (2.08–4.52)*	3.49 (2.33–5.22)*	2.72 (1.71–4.33)**	2.31 (1.25–4.26)**
Women	n = 951	n = 607	n = 1127	n = 662	n = 448	n = 125
Short sleep (<7 h/night)						
Model 1	1.00	2.12 (1.77–2.53)*	2.52 (2.15–2.95)*	2.43 (2.04–2.88)*	1.62 (1.30–2.01)*	1.71 (1.24–2.37)**
Model 2	1.00	2.18 (1.63–2.93)*	2.27 (1.74–2.98)*	2.36 (1.75–3.19)*	1.64 (1.15–2.33)**	2.11 (1.40–3.18)*
Model 3	1.00	2.17 (1.59–2.96)*	2.27 (1.71–3.00)*	2.23 (1.61–3.08)*	1.64 (1.07–2.50)**	1.81 (1.05–3.12)**

Model 1: adjusted for age, Model 2: Age, education, and employment, Model 3: Age, education, employment and shift work.

* $p < 0.001$.

** $p < 0.05$.

Table 3

Prevalence ratio(s) for long sleep among ethnic minority groups compared with ethnic Dutch.

	Dutch	South-Asian Surinamese PR (95% CI)	African Surinamese PR (95% CI)	Ghanaian PR (95% CI)	Turkish PR (95% CI)	Moroccan PR (95% CI)
Men	<i>n</i> = 816	<i>n</i> = 549	<i>n</i> = 685	<i>n</i> = 455	<i>n</i> = 396	<i>n</i> = 138
Long sleep (≥ 9 h/night)						
Model 1	1.00	1.09 (0.68–1.76)	0.73 (0.44–1.22)	0.92 (0.54–1.59)	1.43 (0.89–2.29)	1.91 (1.05–3.48)**
Model 2	1.00	0.78 (0.40–1.51)	0.55 (0.27–1.13)	0.84 (0.41–1.75)	0.91 (0.43–1.95)	1.28 (0.55–2.97)
Model 3	1.00	0.56 (0.25–1.26)	0.47 (0.22–1.03)	0.85 (0.40–1.82)	0.68 (0.28–1.70)	1.04 (0.40–2.71)
Women	<i>n</i> = 951	<i>n</i> = 607	<i>n</i> = 1127	<i>n</i> = 662	<i>n</i> = 448	<i>n</i> = 125
Long sleep (≥ 9 h/night)						
Model 1	1.00	1.47 (1.02–2.12)**	0.98 (0.69–1.39)	1.54 (1.08–2.20)**	1.87 (1.29–2.70)**	1.99 (1.16–3.40)**
Model 2	1.00	1.09 (0.63–1.89)	0.76 (0.45–1.27)	1.01 (0.59–1.72)	1.19 (0.70–2.01)	0.97 (0.45–2.08)
Model 3	1.00	1.25 (0.65–2.40)	0.88 (0.47, 1.63)	1.25 (0.66–2.36)	1.62 (0.79–3.31)	2.04 (0.84–4.96)

Model 1: adjusted for age, Model 2: Age, education, and employment, Model 3: Age, education, employment and shift work.

* $p < 0.001$.** $p < 0.05$.

sleep, interaction was formally tested and there was significant interaction between education and the ethnic groups, but only in the women category. Interaction results show that all ethnic minority women with secondary and tertiary education were more likely to report short sleep than ethnic-Dutch with same educational level.

4. Discussion

Our study findings indicate that all ethnic minority groups were more likely to report shorter sleep duration than the ethnic-Dutch, in both men and women. Contribution of ethnic differences in educational level to ethnic differences in short sleep was small. There were ethnic differences in long sleep for Moroccan men and women, as well as in South-Asian Surinamese, Ghanaian, and Turkish women compared with ethnic-Dutch. SES explains the observed differences in long sleep but contribution of SES to ethnic differences in short sleep was small.

Our present finding on the higher prevalence of short sleep among ethnic minority groups compared with the ethnic-Dutch confirms some previous studies in the United States, which also found a higher prevalence of short sleep duration (< 7 h/night) among ethnic minority groups, including African Americans, Hispanics, and Asian Americans compared with White Americans [14,15]. The reasons for the high prevalence of short sleep found among ethnic minority groups are unclear but may be attributed to other factors such as migration stress, environmental and cultural factors rather than socio-economic indicators. It is a known fact that ethnic minority groups usually perform different kinds of jobs, and sometimes multiple jobs which may deprive them of the ideal time for sufficient sleep. Since socio-economic indicators (education and employment) differences contributed little to the observed ethnic differences in short sleep, it seems that the observed difference may be more of job-related in some ethnic minority groups than in others. Short sleep can be caused by undue stress which accompanies rigorous tasks in workplaces and in the environment in which ethnic minority groups live. The negative effect of stress on sleep has been documented [27,28]; thus psychosocial stress due to migration and perceived discrimination may have undesirable effects on sleep in migrant and ethnic minority populations. Congested and noisy environment arising from various sources negatively affect night sleep of residents living in these areas [29,30]. In addition to work and stress-related factors, cultural practices such as communal sleeping habits, notably common among African Surinamese [30] beliefs and attitudes toward sleep [28,29], can affect normal sleep schedules, and therefore may contribute to high prevalence of short sleep among ethnic minority groups. For instance, it has been suggested that although some people may report short sleep duration, they

may seem contented owing to their belief that hard-working and successful people require short sleep duration [28,31]. Also other factors such as inherent values ascribed to sleep [32], bedtimes [33–36] and napping [34,37–40] have been shown to differ among adults in various parts of the globe and may also differ among ethnic minority groups in our study. It could be that ethnic minority groups value sleep less, have delayed bedtimes and nap more, which may result in shorter sleep duration compared with ethnic-Dutch. This needs to be further investigated. In addition, literature indicates that acculturation seems to play a protective role in several health behaviours, for example, in greater exercise and leisure-time physical activity [41]. However, using primary language spoken as basis for assessing acculturation, Whinnery et al. [42] demonstrated that exclusively Spanish-speaking households were 2–3 times less likely to report very short sleep compared to primarily English-speaking households. Another study conducted on younger Hispanics living in the USA indicated that acculturation was associated with decreased likelihood of health-promoting behaviour such as hours of sleep per night [43], which seem to suggest that acculturation did not have a protective role in these studies. Thus, it could be said that the role of acculturation may differ from one ethnic group to another. However, we did not investigate the role of acculturation with respect to sleep duration.

Shift work is known to be highly related to sleep duration, and ethnic minority groups tend to do more shift work than the host populations [22,23,44]. Shift work (night shift or other unconventional hours as in multiple jobs) has the potential to disrupt circadian rhythm thereby affecting physiological, biochemical, behavioural, and other related processes of the body, and making normal sleeping difficult [45]. Previous studies show that ethnic minority groups have higher prevalence of short sleep due to shift work when compared with non-Hispanic Whites [23,46]. However, the ethnic differences in short sleep persisted after adjustment for ethnic differences in shift work in our study.

Overall, the contribution of socio-economic indicators on ethnic differences in short sleep was small. This finding is consistent with a previous study which found that though substantial ethnic differences in sleep exists, the differences were not accounted for by SES [21]. On the other hand, this finding is opposed to some other studies which found that ethnic groups with lower SES report lower sleep duration and sleep quality than those with higher SES [17–20]. The reasons for these inconsistent results are not clear. It could be that SES measures vary between studies, or the extent of the variation in SES differs between studies. On one hand, we found that socio-economic indicators were associated with ethnic differences in long sleep particularly in women. This is in accordance with previous study which suggests that long sleep is associated with lower SES [20]. On the other hand, this finding is opposed to another

study which suggests that SES (education) was not related to sleep [21]. In the association between education and short sleep, education was inversely related to short sleep but only in the ethnic-Dutch group. This finding agrees with previous studies by Hale [44,45] and Grandner et al. [20], that people in lower educational category are more likely to have short sleep duration compared to those in higher education categories. For the ethnic minority groups, irrespective of educational level, education does not relate to short sleep. The reason for the observed difference in the association between education and short sleep in the ethnic-Dutch and ethnic minority groups is not clear, but may be attributed to less awareness and disregard of the implications of short sleep by ethnic minority groups compared with ethnic-Dutch.

The strength of our study lies in the large sample size used in most of the ethnic groups, hence providing a more reliable result. Also multiple ethnic groups were investigated together in a similar manner. However, the study has some weaknesses such as the use of self-reported data, which can be prone to subjective bias; the participants may have under- or over-reported short or long sleep duration. Being a cross-sectional study, the relationship between ethnic groups, socio-economic indicators, and sleep duration may not be generalised, even though associations were observed. Also, information about daytime sleeping and cultural attitudes such as inherent values ascribed to sleep, bedtimes, and napping, which may affect sleep were lacking in the original dataset. Despite these shortcomings, our study shows a distinct and relevant result on ethnic differences in sleep duration among residents in Europe.

In conclusion, our current findings show that ethnic minority groups report shorter sleep duration compared with their ethnic-Dutch counterparts. Hence, it might be interesting to further investigate how these ethnic differences in short sleep may be related to ethnic differences in mental health, and possibly contribute to ethnic inequalities in health outcomes such as cardiovascular disease.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <http://dx.doi.org/10.1016/j.sleep.2014.04.019>.

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Appendix: Supplementary Material

Supplementary data to this article can be found online at [doi:10.1016/j.sleep.2014.04.019](http://dx.doi.org/10.1016/j.sleep.2014.04.019).

References

- [1] Agyemang C, Addo J, Bhopal R, Aikins Ade G, Stronks K. Cardiovascular disease, diabetes and established risk factors among populations of sub-Saharan African descent in Europe: a literature review. *Global Health* 2009;5:7.
- [2] Kurian AK, Cardarelli KM. Racial and ethnic differences in cardiovascular disease risk factors: a systematic review. *Ethn Dis* 2007;17(1):143–52.
- [3] Jonkers M, Richters A, Zwaart J, Ory F, Van Roosmalen J. Ethnic differences in maternal morbidity in the Netherlands: anthropological reflections on socio-ethnic determinants. *Int J Psychosom Obstet Gynecol* 2007;28:48.
- [4] Mackenbach JP, Bos V, Garssen MJ, Kunst AE. Mortality among non-western migrants in The Netherlands. *Ned Tijdschr Geneesk* 2005;149(17):917–23.
- [5] van Oeffelen AA, Vaartjes I, Stronks K, Bots ML, Agyemang C. Incidence of acute myocardial infarction in first and second generation minority groups: does the second generation converge towards the majority population? *Int J Cardiol* 2013;168(6):5422–9.
- [6] Finkelstein EA, Khavjou OA, Mobley LR, Haney D, Will JC. Racial/ethnic differences in coronary heart disease risk factors among WISEWOMEN enrollees. *J Womens Health (Larchmt)* 2004;13(5):503–18.
- [7] Fassaert TJL, De Wit MAS, Verhoeff AP, Tuinebreijer WC, Gorissen WHM, Beekman ATF, et al. Uptake of health services for common mental disorders by first-generation Turkish and Moroccan migrants in The Netherlands. *BMC Public Health* 2009;23:307.
- [8] Ramon S. Inequality in mental health. The relevance of current research and understanding to potentially effective social work responses. *Radical Psychol* 2007;6(1):1–20.
- [9] Stronks K, Ravelli AC, Reijneveld SA. Immigrants in the Netherlands. Equal access for equal needs? *J Epidemiol Community Health* 2001;55(10):701–7.
- [10] Shankar A, Charumathi S, Kalidindi S. Sleep duration and self-rated health: the National Health Interview Survey. *Sleep* 2008;34(9):1173–7.
- [11] Profant J, Ancoli-Israel S, Dimsdale JE. Are there ethnic differences in sleep architecture? *Am J Hum Biol* 2002;14(3):321–6.
- [12] Department of Health and Human Services. 2003. Sleep disorders research plan. Washington, DC: Department of Health and Human Services.
- [13] Quereshi AI, Giles WH, Croft JB, Bliwise DL. Habitual sleep patterns and risk for stroke and coronary heart disease: a 10-year follow-up from NHANES 1. *Neurology* 1997;48(4):904–11.
- [14] Kripke DF, Brunner R, Freeman R, Hendrix SL, Jackson RD, Masaki K, et al. Sleep complaints of postmenopausal women. *Clin J Womens Health* 2001;1(5):244–52.
- [15] Park A "How well do you sleep? The answer may depend on your race", Time, Time Inc., 2012, Web. 10 August 2013.
- [16] Jean-Louis G, Magai CM, Cohen CI, Zizi F, von Gizycki H, DiPalma J, et al. Ethnic differences in self-reported sleep problems in older adults. *Sleep* 2001;24(8):926–33.
- [17] Gellis LA, Lichstein KL, Scarinci IC, Durrence HH, Taylor DJ, Bush AJ, et al. Socioeconomic status and insomnia. *J Abnorm Psychol* 2005;114(1):111–18.
- [18] Patel NP, Gooneratne N, Xie D, Branas CC. Poverty effects on population sleep. *Sleep* 2008;31:A353.
- [19] Grandner MA, Patel NP, Gehrman PR, Xie D, Sha D, Weaver T, et al. Who gets the best sleep? Ethnic and socioeconomic factors related to sleep complaints. *Sleep Med* 2010;11(5):470–8.
- [20] Mezick EJ, Matthews KA, Hall M, Strollo PJ, Buysse DJ, Kamarck TW, et al. Influence of race and socioeconomic status: Pittsburgh Sleep SCORE Project. *Psychosom Med* 2008;70(4):410–16.
- [21] Hall MH, Matthews KA, Kravitz HM, Gold EB, Buysse DJ, Bromberger JT, et al. Race and financial strain are independent correlates of sleep in midlife women: The SWAN Study. *Sleep* 2009;32(1):73–82.
- [22] Luckhaupt SE. Short sleep duration among workers – United States, 2010. *Weekly* 2012;61(16):281–5.
- [23] US Department of Labour Bureau of Statistic. (2005). Workers on flexible and shift schedules in May 2004. Available from <http://www.bls.gov/news.release/flex.toc.htm> [accessed 13.12.22.].
- [24] Stronks K, Snijder MB, Peters RJ, Prins M, Schene AH, Zwinderman AH. Unravelling the impact of ethnicity on health in Europe: the HELIUS study. *BMC Public Health* 2013;13:402.
- [25] Sleep guidelines for adults. (2012). Available from <http://www.sleepfoundation.org/alert/new-research-identity-and-treat-insomnia-early-reduce-risk-other-illness> [accessed 12.04.19].
- [26] Stronks K, Kunst AE. The complex interrelationship between ethnic and socio-economic inequalities in health. *J Public Health (Oxf)* 2009;31(3):324–5.
- [27] Sadeh A, Keinan G, Daon K. Effects of stress on sleep: the moderating role of coping style. *Health Psychol* 2004;23(5):542–5.
- [28] Amira S. External factors that influence sleep. Healthy Sleep Division of Sleep Medicine at Harvard Medical School, 2007; Web 15 September 2013. healthysleep.med.harvard.edu/healthy/science/how/external-factors.
- [29] Knutson KL. Does inadequate sleep play a role in vulnerability to obesity? *Am J Hum Biol* 2012;24:361–71.
- [30] CultureGram 2012 World Editions – Republic of Suriname. <http://www.culturegrams.com/images/samples/SurinameWorld.pdf> [accessed 14.03.21].
- [31] Hollan D. Sleeping, dreaming, and health in rural Indonesia and the U.S. urban: a cultural and experiential approach. *SocSci Med* 2013;79:23–30.
- [32] Worthman CM, Brown RA. Sleep budgets in a globalizing world: biocultural interactions influence sleep sufficiency among Egyptian families. *Soc Sci Med* 2013;79:31–9.
- [33] Knutson K. Sociodemographic and cultural determinants of sleep deficiency: implications for cardiometabolic disease risk. *Soc Sci Med* 2013;79:7–15.
- [34] Saldatos CR, Allaert FA, Ohta T, Dikeos DG. How do individuals sleep around the world? Results from a single-day survey in ten countries. *Sleep Med* 2005;6(1):5–13.
- [35] LeBourgeois MK, Giannotti F, Cortesi F, Wolfson AR, Harsh J. The relationship between reported sleep quality and sleep hygiene in Italian and American adolescents. *Pediatrics* 2005;115(1 Suppl.):257–65.

- [36] Morselli L, Leproult R, Balbo M, Spiegel K. Role of sleep duration in the regulation of glucose metabolism and appetite. *Best Pract Res Clin Endocrinol Metab* 2010;24(5):687–702.
- [37] Reimao R, Souza JC, Gaudio CE, Guerra HD, Alves AD, Oliveira JC, et al. Siestas among Brazilian Native Terena adults: a study of daytime napping. *Arq Neuropsiquiatr* 2000;58(1):39–44.
- [38] National Sleep Foundation. 2005 Sleep in America poll. Washington, DC. Available from <http://www.sleepfoundation.org>.
- [39] Valencia-Flores M, Castano VA, Campos RM, Rosenthal L, Resendiz M, Vergara P, et al. The siesta culture concept is not supported by the sleep habits of urban Mexican students. *J Sleep Res* 1998;7(1):21–9.
- [40] Paraskakis E, Ntoulos T, Ntokos M, Siavana O, Bitsori M, Galanakis E. Siesta and sleep patterns in a sample of adolescents in Greece. *Pediatr Int* 2008;50(5):690–3.
- [41] Crespo CJ, Smith E, Carter-Pokras O, Anderson RE. Acculturation and leisure-time physical inactivity in Mexican Americans adults: results from NHANES III, 1988–1994. *Am J Public Health* 2001;91:1254–7.
- [42] Whinnery J, Jackson N, Rattanaumpawan P, Grandner MA. Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. *Sleep* 2014;37(3):601–11.
- [43] Ebin VJ, Sneed CD, Morisky DE, Rotheram-Borus MJ, Magnusson AM, Malotte CK. Acculturation and interrelationship between problem health-promoting behaviours among Latino adolescents. *J Adolesc Health* 2001;1:62–72.
- [44] Hale L, Do DP. Racial differences in self-reported sleep duration in a population-based study. *Sleep* 2007;30(9):1096–103.
- [45] Hale L. Who has time to sleep? *J Public Health (Oxf)* 2005;27(2):205–11.
- [46] Ertel KA, Berkman LF, Buxton OM. Socioeconomic status, occupational characteristics, and sleep duration in African/Caribbean immigrants and US White health care workers. *Sleep* 2011;34(4):509–18.